REMARKS

The present invention is the novel combination of a PH-VAN (perfect homeotropic vertically aligned nematic type liquid crystal cell, as a reflective cell) and circular polarization of incoming and reflected light to provide a low cost, high contrast display. The closer the alignment is to homeotropic, the higher the contrast. Vertical alignment is easily achieved with the PH-VAN cell, as it is the lowest energy state of many polyimides. No rubbing or UV alignment step is needed, which significantly reduces manufacturing costs. The use of quarter wave plates to make the polarization circular, instead of linear, when it hits the display, makes the transmittance through the cell independent of the azimuthal orientation of the PH-VAN director profile with use of circular polarizers in a reflective liquid crystal display, which eliminates the need for director alignment as is required with planar polarized light. With no director alignment, there is no fringing field induced by director tilt and no consequent decrease in the light transmittance from the cell. This enables the use of a perfectly homeotropic vertically aligned nematic type cell irrespective of domain size and shape. The prior art does not teach or suggest this novel combination of components to provide an efficient light valve. The use of circular polarizers allows easing of the restrictions on the directors, so that simpler displays can be made with the same or improved performance.

Claims 1-2, 7-9, 13-15, 24 and 28-29 were rejected under 35 U.S.C. 103(a) as unpatentable over Koma (No. 6,188,456) in view of Chigrinov (No. 5,784,139). The Examiner notes that Koma discloses a vertically aligned reflective liquid crystal cell, and that Chigrinov teaches the use of circular polarizers instead of "plane" polarizers. Koma does not disclose the use of a homeotropic vertically aligned nematic mode cell, much less the novel combination of a PH-VAN cell in combination with circular polarizers, to ease design and manufacturing restrictions on alignment of the liquid crystals at the surface, as the present invention does.

The cell described by Koma does not achieve alignment by the combination of a PH-VAN cell with circular polarization. In Koma, the electrode is modified to control the fringing field, to orient the liquid crystal directors such that they make a 45 degree angle to the polarizers. This is accomplished by shaping the electrodes to control the fringing electric field lines. See Koma, Fig.1 (alignment control window 34), and col. 2, lines 62-65; col. 7, lines 39-42; col. 8,

lines 31-34. Only by this precise modification of the electrode to establish pre-tilt in the electric field does Koma achieve vertical alignment. In the present invention there is no adjustment of director alignment, pre-tilt, or of the electric field.

Chigrinov, U.S. Patent No. 5,784,139, is cited only for disclosure of circular polarizers. Chigronov does not disclose or suggest the use of circular polarizers in combination with a PH-VAN cell to produce a high contrast reflective liquid crystal display. Chigrinov notes, at column 3, lines 53-54, merely that "circular polarizers can be used instead of plane polarizers" only for the disclosed purpose of orienting the output crosswise or 90° to the input light, and not for the purpose of eliminating a director alignment and avoiding induced fringing fields. Thus, Chigrinov's passing mention of the possible use of a circular polarizer as a substitute polarization device does not suggest use in combination with a PH-VAN cell, as claimed in this application.

As for claims 2 and 15, although Koma discloses light on axis to a first polarizer, as noted Koma is relying upon a modified electrode to control fringing fields, not on-axis light to a circular polarizer. Because Chigronov does not suggest the use of circular polarizers in combination with a PH-VAN type cell to eliminate the need for director alignment, and thereby eliminate fringing fields, the unsuggested combination of these two references does not result in the invention as claimed.

As for claims 7-8 and 13-14, the alignment control window region 34 of Koma is formed as an electrode-free area of the common electrode 32. This is not a PH-VAN type liquid crystal cell as disclosed and claimed by the present application, page 11, lines 17-20, wherein the liquid crystal molecules are 90° from the cell surface. In Koma, there would only be an absence of director pre-tilt in region 34. Because Koma uses region 34 as an alignment control window to set the viewing angle of the display, there is no need or motivation to use circular polarizers to reduce or eliminate fringing fields. Koma, col. 8, lines 8-15. Therefore, Koma lacks disclosure of both a PH-VAN cell as claimed, and circular polarizers, and the combination thereof. The mere mention of the use of circular polarizers for use with a different non-PH-VAN type cell does not suggest the combination as claimed.

As for claims 24 and 28, again Koma does not disclose a LC cell which has no pre-tilt mechanism, because the electrode of Koma is modified to create the electrode-free alignment

control region 34. And Chigronov does not disclose or suggest the use of incoming and outgoing circular polarizers in combination with a PH-VAN cell to take advantage of the inherent high-contrast characteristics of the PH-VAN cell, and to avoid the necessity for any director pre-tilt.

As for claims 4, 10 and 25, it is known in the art to provide a circular polarizer by the combination of a linear polarizer and quarter wave retarder, as taught for example by Borrego. It is not known or suggested by the prior art to use this form of circular polarizer in combination with a PH-VAN cell to provide a high-contrast liquid crystal display as claimed.

As for claims 5, 11 and 26, the disclosure by Conner of the use of cholosteric film as a circular polarizer is not in combination with a PH-VAN cell, but rather with a "an LCD that exhibits an electronically controllable birefringent effect, such as as STN-LCD. Conner, col. 4, lines 25-27. None of the three combined references teach or suggest the PH-VAN cell/circular polarizer combination.

As for claims 6, 12 and 27, Levola discloses only the known use of a LCOS type cell in a projection device, not a PH-VAN liquid crystal on silicon cell, and not in combination with circular polarizers.

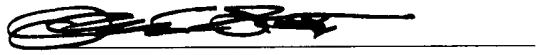
CONCLUSION

Due to the absence of disclosure by the cited references of the combination of limitations recited by the present claims, it is respectfully submitted that the claims are patentably distinct over the art of record and in condition for allowance. If the Examiner believes there are any further matters, which need to be discussed in order to expedite the prosecution of the present application, the Examiner is invited to contact the undersigned.

If there are any other fees necessitated by the foregoing communication, please charge such fees to our Deposit Account No. 50-0959, referencing our Docket No. 109784.0001.

Respectfully submitted,
ROETZEL & ANDRESS

Sep. 3, 2003
Date



James C. Scott
Reg. No. 35,351
1375 E. 9th Street
One Cleveland Center, 10th Floor
Cleveland, Ohio 44114
(216) 623-0150 (reception)
(216) 615-4832 (direct)
(216) 623-0134 (facsimile)

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(Typed or Printed Name of Person Mailing Paper)

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